AMENDMENTS TO THE SPECIFICATION

Please amend the specification as follows:

Please replace the paragraph beginning on page 10, line 27 with the following amended paragraph:

An objective lens for an optical pickup device of ~~claim 1~~ the first embodiment is an objective lens used for an optical pickup device,

wherein the optical pickup device comprises: a light source; and a converging optical system including the objective lens for converging a light beam emitted from the light source to an information recording surface of an optical information recording medium, and the optical pickup device is capable of recording and/or reproducing information by converging the light beam emitted from the light source to the information recording surface of the optical information recording medium with the converging optical system, and

wherein the objective lens is a plastic single lens and satisfies following formulas:

$$NA \geq 0.8 \quad (1)$$

$$1.0 > f > 0.2 \quad (2)$$

where NA is an image-side numerical aperture of the objective lens, which is required for recording and/or reproducing information to the optical information recording medium and f (mm) is a focal length of the objective lens.

Please replace the paragraph beginning on page 11, line 24 with the following amended paragraph:

The variation of spherical aberration owing to change of the refractive index of the plastic single lens accompanying temperature rise (thermal aberration) increases in proportion to the focal length and 4th power of the NA. Accordingly, even in cases of increasing the NA for densifying an optical information recording medium, it is made possible to comparatively suppress the thermal aberration by reducing the focal length according thereto. Therefore, as for the objective lens of ~~claim 1~~ the first embodiment, by setting the upper limit of the focal length as the formula (2), thermal aberration is prevented from increasing excessively even in case of a plastic single lens having a high NA that satisfies the formula (1). Furthermore, as for a plastic single lens of a refraction type, it is impossible to make thermal aberration zero completely. However, it is possible to suppress the thermal aberration in a temperature range of practical use of the optical pickup device into an allowable range by making the focal length not excess the upper limit of the formula (2).

Please replace the paragraph beginning on page 12, line 16 with the following amended paragraph:

On the other hand, though reduction of the focal length is advantageous from the viewpoint of suppressing the generation amount of thermal aberration, excessive reduction of the focal length is disadvantageous from the viewpoint of the working distance and image height characteristics. As for design of an objective lens having a high NA, securing the focal length is a very important problem for preventing clash with

an optical information recording medium. When the focal length is reduced excessively, the working distance is lost by that amount, which is not favorable. When trying to obtain the same image height as an objective lens having a relatively long focal length, astigmatic aberration and coma aberration are degraded because an incident angle to an objective lens having a relatively short focal length increases. Accordingly, it is not favorable to reduce the focal length of the objective lens also from the viewpoint of image height characteristics. Therefore, the objective lens of ~~claim 1~~ of the first embodiment secured the necessary and sufficient working distance and image height characteristics by setting the upper limit of the focal length as the formula (2).

Please replace the paragraph beginning on page 13, line 11 with the following amended paragraph:

An objective lens for the optical pickup device of ~~claim 2~~ consistent with the first embodiment is characterized in that~~, in the invention of claim 1,~~ when $W(\lambda_0, T_0)$ is an RMS value of residual aberration of the objective lens a first ambient temperature T_0 = 25 °C and $W(\lambda_0, T_1)$ is an RMS value of residual aberration of the objective lens when light having the wavelength of λ_0 (nm) which is a design wavelength thereof is incident to the objective lens at the environmental temperature which is a second ambient temperature T_1 = 55 °C, ΔW defined by

$$\Delta W = |W(\lambda_0, T_1) - W(\lambda_0, T_0)| \qquad (3)$$

satisfies a following formula:

$$\Delta W < 0.035\ \lambda rms \qquad (4)$$

Please replace the paragraph beginning on page 14, line 7 with the following amended paragraph:

An objective lens for the optical pickup device ~~of claim 3~~ according to the present invention is characterized in that, in the objective lens for the optical pickup device of ~~claim 1 or 2~~ the first embodiment, the design wavelength λ_0 of the optical objective lens is not more than 500 nm, and in case that $fB(\lambda_0, T_0)$ is an back focal length of the objective lens when light having a wavelength of λ_0 (nm) is incident to the objective lens at an environmental temperature which is a first ambient temperature T_0 = 25 °C and $fB(\lambda_1, T_0)$ is a back focal length of the objective lens when light having a wavelength of λ_1 (nm) which is 5 nm longer than the wavelength of λ_0 is incident to the objective lens in the environmental temperature which is the first ambient temperature T_0 = 25 °C, ΔfB defined by

$$\Delta fB = |fB(\lambda_1, T_0) - fB(\lambda_0, T_0)| \quad (5)$$

satisfies a following formula:

$$\Delta fB < 0.001 \text{ mm} \quad (6)$$

Please replace the paragraph beginning on page 14, line 24 with the following amended paragraph:

The longitudinal chromatic aberration due to mode hopping of a laser diode increases in proportion to the focal length. Accordingly, even in case of using, for example, a blue-violet laser diode as the light source, it becomes possible to suppress the longitudinal chromatic aberration comparatively when the focal length is reduced corresponding thereto. As for a single lens of a refraction type, it is impossible to make

chromatic aberration zero completely. However, it is possible to suppress the variation of wavefront aberration including a defocus component less than 0.035 λrms for the variation of wavelength due to mode hopping of the blue-violet laser diode when variation of the back focal length in increasing the incident wavelength by 5 nm is made less than 0.001 mm (the formula (6)) in an object lens, ~~such as the objective lens of claim 3,~~ in which the focal length is set so as to satisfy the formula (2) and a blue-violet laser diode is used as a light source. Therefore, conversing ability is not degraded significantly even when mode hopping is caused in switching from the reproducing condition to the recording condition.

Please replace the paragraph beginning on page 15, line 19 with the following amended paragraph:

An objective lens for the optical pickup device ~~of claim 4~~ further consistent with the first embodiment is characterized in that~~, in the invention of any one of claims 1 to 3,~~ the objective lens is an objective lens of a finite conjugate type for converging a diverging light beam emitted from the light source to the information recording surface of the optical information recording medium and satisfies a following formula:

$$0.8 > f > 0.2 \tag{6A}$$

Please replace the paragraph beginning on page 16, line 1 with the following amended paragraph:

The objective lens ~~of claim 4~~ is preferable as an objective lens for an optical pickup device of which miniaturization is required, and for example, may be used as an

objective lens for an optical pickup device installed in a portable optical disk player. In order to obtain an objective lens of a finite conjugate type having an image formation magnification of m and brightness as much as an objective lens of an infinity type, it is necessary to design a lens having brightness (1-m) times as much as the image-side numerical aperture of the objective lens of an infinity type. The sign of m becomes minus and the substantial image-side numerical aperture becomes larger than the image-side numerical aperture of the objective lens of an infinity type in case that the objective lens is a finite conjugate type that converges a diverging light beam emitted from the light source on the information recording surface of the optical information recording medium. Accordingly, the thermal aberration is made large than the objective lens of the infinity type when the objective lens of the finite conjugate type is made a plastic single lens. In the objective lens ~~of claim 4~~ consistent with the first embodiment, by making the upper limit of the focal length further less than the formula (2) and setting it as the formula (6A), it is possible to suppress thermal aberration in an allowable range of practical use even in case of a plastic single lens of a finite conjugate type having a high NA as the NA satisfies the formula (1). In the objective lens of the finite conjugate type for converging a diverging light beam, the working distance becomes larger as compared to the objective lens of the infinity type having the same focal length. Accordingly, it is not disadvantageous from the viewpoint of securing the working distance also in case of making the upper limit of the focal length further less than the formula (2) as the objective lens ~~of claim 4~~ according to the first embodiment.

Please replace the paragraph beginning on page 17, line 9 with the following amended paragraph:

An objective lens for an optical pickup device ~~of claim 5~~ further consistent with the first embodiment is characterized in that~~, in the invention of claim 4,~~ m satisfies following formula when m is an image formation magnification of the objective lens:

$0.2 > |m| > 0.02$ (6B)

Please replace the paragraph beginning on page 17, line 24 with the following amended paragraph:

An objective lens used for an optical pickup device of ~~claim 6~~ the second embodiment is an objective lens used for an optical pickup device, wherein the optical pickup device comprises a light source; and a converging optical system including an objective lens for converging a light beam emitted from the light source to an information recording surface of an optical information recording medium, and the optical pickup device is capable of recording and/or reproducing information by converging the light beam emitted from the light source to the information recording surface of the optical information recording medium with the converging optical system,

wherein the objective lens is a plastic single lens that comprises a ring-shaped phase structure on at least one optical surface, the ring-shaped phase structure comprising a plurality of ring surfaces and formed so that adjacent ring surfaces generate a predetermined optical path difference for incident light, and satisfies following formulas:

$NA \geq 0.8$ (7)

$1.3 > f > 0.2$ (8)

where NA is an image-side numerical aperture of the objective lens, which is required for recording and/or reproducing information for the optical information recording medium and f (mm) is a focal length of the objective lens.

Please replace the paragraph beginning on page 19, line 19 with the following amended paragraph:

As for the objective lens of ~~claim 6~~ the second embodiment, it is possible to prevent chromatic spherical aberration after correcting thermal aberration from excessively increasing, because the correction amount of thermal aberration due to the effect of the ring-shaped phase structure is suppress low by setting the upper limit of the focal length as the formula (8). As a result of this, as for an optical pickup device in which the objective lens due to the present invention is mounted, it is possible to suppress the production cost because selection of laser diodes in the production step. Meanwhile, though reduction of the focal length is advantageous from the viewpoint of suppressing the generation amount of thermal aberration, excessive reduction of the focal length is disadvantageous from the viewpoint of the working distance and image height characteristics. Therefore, the objective lens of the present invention secured the necessary and sufficient working distance and image height characteristics by setting the upper limit of the focal length as the formula (8).

Please replace the paragraph beginning on page 21, line 25 with the following amended paragraph:

As for an objective lens for the optical pickup device ~~of claim 7~~ consistent with the second embodiment, ~~in the invention of claim 6,~~ the ring-shaped phase structure is a diffraction structure having a function for diffracting predetermined incident light and the objective lens forms a converging wave front which is converged on the information recording surface owing to an effect obtained by combining a diffraction effect and a refraction effect, and the above-described operation is exerted effectively and thereby it is preferable.

Please replace the paragraph beginning on page 22, line 8 with the following amended paragraph:

An objective lens for the optical pickup device ~~of claim 8~~ further consistent with the second embodiment has spherical aberration characteristics that spherical aberration changes in an undercorrected direction when a wavelength of the incident light changes to a longer wavelength ~~in the invention of claim 7~~.

Please replace the paragraph beginning on page 24, line 15 with the following amended paragraph:

An objective lens for the optical pickup device ~~of claim 9~~ further consistent with the second embodiment is characterized in that~~, in the invention of claim 7 or 8,~~ when an optical path difference added to a wave front transmitted through the diffraction structure is denoted by an optical path difference function Φ_b defined by

$$\Phi_b = b_2 \cdot h^2 + b_4 \cdot h^4 + b_6 \cdot h^6 + \ldots$$

(wherein b_2, b_4, b_6... are 2nd-order, 4th-order, 6th-order... optical path difference function coefficients, respectively), a following formula is satisfied:

$$-70 < (b_4 \cdot h_{MAX}^4) / (f \cdot \lambda_0 \cdot 10^{-6} \cdot (NA \cdot (1-m))^4) < -20 \qquad (8A)$$

wherein λ_0 (nm) is a design wavelength of the objective lens, h_{MAX} is an effective diameter maximum height (mm) of the optical surface on which the diffraction structure is formed and m is an image formation magnification of the objective lens.

Please replace the paragraph beginning on page 26, line 5 with the following amended paragraph:

As for an objective lens for the optical pickup device ~~of claim 10~~ further consistent with the second embodiment, ~~in the invention of claim 6,~~ the ring-shaped phase structure generates the predetermined optical path difference for the incident light by forming the adjacent ring surfaces so as to be displaced in an optical axis direction each other, and the objective lens forms a converging wave front which is converged on the information recording surface owing to a refraction effect, and the above-described operation is exerted effectively and thereby it is preferable.

Please replace the paragraph beginning on page 26, line 15 with the following amended paragraph:

An objective lens for the optical pickup device ~~of claim 11~~, according to another variation of the second embodiment, ~~in the invention of claim 6,~~ comprises at least one ring surface formed to be displaced to the inside compared with a ring surface adjacent

to the side closer to the optical axis and at least one ring surface formed to be displaced to the outside compared with a ring surface adjacent to the side closer to the optical axis, and the ring surface formed to be displaced to the inside compared with a ring surface adjacent to the side closer to the optical axis is formed closer to the optical axis than the ring surface formed to be displaced to the outside compared with a ring surface adjacent to the side closer to the optical axis, and thermal aberration can be well corrected by configuring the ring-shaped phase structure in this way and thereby it is preferable.

Please replace the paragraph beginning on page 27, line 4 with the following amended paragraph:

An objective lens for the optical pickup device ~~of claim 12~~ consistent with the second embodiment is characterized in that~~, in the invention of claim 10 or 11,~~ a total of the ring surfaces is from 3 to 20.

Please replace the paragraph beginning on page 27, line 8 with the following amended paragraph:

An objective lens for the optical pickup device ~~of claim 13~~ according to another variation of the second embodiment is characterized in that~~, in the invention of any one of claims 10 to 12,~~ when Δ_j (μm) is a step amount of an arbitrary step of steps in the optical axis direction at a boundary of mutually adjacent ring surfaces in a ring- shaped phase structure formed in a region from a height of 75% to a height of 100% of an effective diameter maximum height of the optical surface on which the ring-shaped

phase structure is formed and n is a refractive index of the objective lens at a design wavelength of λ_0 (nm), m_j represented by

$$m_j = \mathrm{INT}(X) \qquad (8B)$$

(wherein $X = \Delta_j \cdot (n-1)/(\lambda_0 \cdot 10^{-3})$ and INT(X) is an integer obtained by half adjust of X) is an integer not less than 2.

Please replace the paragraph beginning on page 27, line 22 with the following amended paragraph:

In the objective lens ~~of claims 10 and 11~~ <u>according to the second embodiment</u>, a total of the ring surfaces is from 3 to 20, and additionally, when Δ_j (μm) is a step amount of an arbitrary step of steps in the optical axis direction at a boundary of mutually adjacent ring surfaces in a ring-shaped phase structure formed in a region from a height of 75% to a height of 100% of an effective diameter maximum height of the optical surface on which the ring-shaped phase structure is formed and n is a refractive index of the objective lens at a design wavelength of λ_0 (nm), m_j represented by the above-described (8B) is an integer not less than 2, and mold process for molding an objective lens becomes easy and time spent for the mold process can be reduced because it is possible to secure a large width of a ring surface in the direction perpendicular to the optical axis.

Please replace the paragraph beginning on page 29, line 14 with the following amended paragraph:

An objective lens for the optical pickup device ~~of claim 14~~ consistent with a further variation of the second embodiment is characterized in that~~, in the invention of any one of claims 6 to 13,~~ when $W(\lambda_0, T_0)$ is an RMS value of residual aberration of the objective lens when light having a wavelength of λ_0 (nm) which is a design wavelength thereof is incident to the objective lens at an environmental temperature which is a first ambient temperature T_0 = 25 °C, $W(\lambda_1, T_0)$ is an RMS value of residual aberration of the objective lens when light having a wavelength of λ_1 (nm) which is 5 nm longer than the wavelength of λ_0 is incident to the objective lens at the environmental temperature which is the first ambient temperature T_0 = 25 °C and $W(\lambda_2, T_1)$ is an RMS value of residual aberration of the objective lens when light having a wavelength of λ_2 (nm) is incident to the objective lens at the environmental temperature which is a second ambient temperature T_1 = 55 °C, $\Delta W1$ and $\Delta W2$ defined by

$$\Delta W1 = |W(\lambda_2, T_1) - W(\lambda_0, T_0)| \quad (9)$$

$$\Delta W2 = |W(\lambda 1, T_0) - W(\lambda_0, T_0)| \quad (10)$$

satisfy following formulas:

$$\Delta W1 < 0.035\ \lambda\text{rms} \quad (11)$$

$$\Delta W2 < 0.035\ \lambda\text{rms} \quad (12)$$

wherein

when $\lambda_0 < 600$ nm, $\lambda_2 = \lambda_0 + 1.5$ (nm) and

when $\lambda_0 \geq 600$ nm, $\lambda_2 = \lambda_0 + 6$ (nm).

Please replace the paragraph beginning on page 31, line 7 with the following amended paragraph:

~~As the objective lens of claim 14, the~~ The condition that when $\lambda_0 < 600$ nm, $\lambda_2 = \lambda_0 + 1.5$ (nm) corresponds the change (+0.05 nm/°C) of the emission wavelength owing to temperature rise of a blue-violet laser diode, and the condition that when $\lambda_0 \geq 600$ nm, $\lambda_2 = \lambda_0 + 6$ (nm) corresponds the change (+0.2 nm/°C) of the emission wavelength owing to temperature rise of a red laser diode.

Please replace the paragraph beginning on page 32, line 1 with the following amended paragraph:

An objective lens for the optical pickup device ~~of claim 15~~ according to a further variation of the second embodiment is characterized in that the objective lens satisfies [[a]] the following formula ~~in the invention of claim 14, and thereby it is preferable~~.

Please replace the paragraph beginning on page 32, line 6 with the following amended paragraph:

An objective lens for the optical pickup device ~~of claim 16~~ in accordance with another variation of the second embodiment is characterized in that~~, in the invention of any one of claims 6 to 15,~~ the objective lens is an objective lens of a finite conjugate type for converging a diverging light beam emitted from the light source on the information recording surface and satisfies a following formula:

$$1.1 > f > 0.2 \qquad (13A)$$

The operation and effect of this invention is the same as the operation and effect ~~of the invention of claim 4~~ consistent with the first embodiment.

Please replace the paragraph beginning on page 32, line 15 with the following amended paragraph:

An objective lens for the optical pickup device ~~of claim 17~~ according to a further variation of the second embodiment is characterized in that~~, in the invention of claim 16,~~ the objective lens satisfies a following formula when m is an image formation magnification of the objective lens:

$$0.2 > |m| > 0.02 \tag{13B}$$

The operation and effect of this invention is the same as the operation and effect ~~of the invention of claim 5~~ consistent with the first embodiment.

Please replace the paragraph beginning on page 32, line 23 with the following amended paragraph:

An objective lens for the optical pickup device ~~of claim 18~~ further in accordance with the second embodiment is characterized in that~~, in the invention of any one of claims 1 to 17,~~ the objective lens satisfies a following formula:

$$0.8 < d/f < 1.8 \tag{14}$$

where d (mm) is a lens thickness in an optical axis of the objective lens and f (mm) is a focal length.

Please replace the paragraph beginning on page 34, line 9 with the following amended paragraph:

As for an objective lens for the optical pickup device ~~of claim 19~~ according to a variation of the second embodiment, ~~in the invention of any one of claims 1 to 18,~~ the design wavelength of λ_0 (nm) of the objective lens satisfies a following formula, and it is possible to use it for an optical pickup device equipped with a short-wavelength light source such as a blue-violet laser diode.

Please replace the paragraph beginning on page 34, line 16 with the following amended paragraph:

An objective lens for the optical pickup device ~~of claim 20~~ further consistent with the second embodiment is characterized in that~~, in the invention of any one of claims 1 to 19,~~ the objective lens satisfies a following formula:

$$0.40 \leq (X1 - X2)\cdot(N - 1)/(NA\cdot f\cdot\sqrt{(1 + |m|)}) \leq 0.63 \qquad (16)$$

where

X1: a distance (mm) in an optical axis direction between a plane that is perpendicular to an optical axis and tangent to a top of an optical surface on a light source side and an optical surface on the light source side in a most peripheral portion of an effective diameter (position of the NA on a surface on the light source side to which a marginal light beam is incident), wherein X1 is plus in a case of measuring X1 in a direction of the optical information recording medium with reference to the tangent plane, and minus in a case of measuring X1 in a direction of the light source,

X2: a distance (mm) in an optical axis direction between a plane that is perpendicular to an optical axis and tangent to a top of an optical surface on an optical information recording medium side and an optical surface on the optical information recording medium side in a most peripheral portion of an effective diameter (position of the NA on a surface on the optical information recording medium side to which a marginal light beam is incident), wherein X2 is plus in a case of measuring X2 in a direction of the optical information recording medium with reference to the tangent plane and minus in a case of measuring X2 in a direction of the light source,

N: a refractive index of the objective lens at the design wavelength of λ_0,

f: a focal length (mm) of the objective lens, and

m: an image formation magnification of the objective lens.

Please replace the paragraph beginning on page 35, line 24 with the following amended paragraph:

~~Claim 20~~ The objective lens for the optical pickup device regulates a conditional formula related to the sags of the optical surface on the light source side and the optical surface on the optical information recording medium side for well correcting spherical aberration. As X1 defined as described above is plus and its absolute value is smaller, or as X2 defined as described above is minus and its absolute value is smaller, the effect for overcorrecting the spherical aberration of the marginal light beam becomes higher, and as X1 defined as described above is plus and its absolute value is larger, or as X2 defined as described above is minus and its absolute value is larger, the effect for undercorrecting the spherical aberration of the marginal light beam becomes higher,

and accordingly it is necessary that (X1-X2) is within a certain range in order to correct the spherical aberration. From the foregoing, it is preferable to satisfy the formula (16), and the marginal light beam is not overcorrected excessively when more than the lower limit and the marginal light beam is not undercorrected excessively when less than the upper limit. In particular, in case of an objective lens of an infinity type in which the image formation magnification at the design wavelength λ_0 is zero, it is more preferable to satisfy the following formula:

$$0.40 \leq (X1 - X2)\cdot(N - 1)/(NA\cdot f\cdot\sqrt{}(1 + |m|)) \leq 0.55 \qquad (16')$$

and furthermore, in case of an objective lens of a finite conjugate type which converge a diverging light beam emitted from a light source on the information recording surface, it is more preferable to satisfy the following formula:

$$0.40 \leq (X1 - X2)\cdot(N - 1)/(NA\cdot f\cdot\sqrt{}(1 + |m|)) \leq 0.63 \qquad (16'')$$

Please replace the paragraph beginning on page 37, line 5 with the following amended paragraph:

An optical pickup device ~~of claim 21~~ according to a third embodiment comprises: a light source; and a converging optical system including an objective lens for converging a light beam emitted from the light source to an information recording surface of an optical information recording medium, and is capable of recording and/or reproducing information by converging the light beam emitted from the light source to the information recording surface of the optical information recording medium with the converging optical system,

wherein the objective lens is a plastic single lens and satisfies following formulas:

$NA \geq 0.8$ (1)

$1.0 > f > 0.2$ (2)

where NA is an image-side numerical aperture of the objective lens, which is required for recording and/or reproducing information to the optical information recording medium and f (mm) is a focal length of the objective lens.

Please replace the paragraph beginning on page 37, line 23 with the following amended paragraph:

The operation and effect of this invention is the same as the operation and effect of ~~the invention of claim 1~~ <u>the first embodiment</u>.

Please replace the paragraph beginning on page 37, line 26 with the following amended paragraph:

An optical pickup device ~~of claim 22~~ <u>consistent with the third embodiment</u> is characterized in that~~, in the invention of claim 21,~~ when $W(\lambda_0, T_0)$ is an RMS value of residual aberration of the objective lens when light having a wavelength of λ_0 (nm) which is a design wavelength thereof is incident to the objective lens at an environmental temperature which is a first ambient temperature T_0 = 25 °C and $W(\lambda_0, T_1)$ is an RMS value of residual aberration of the objective lens when light having the wavelength of λ_0 (nm) which is a design wavelength thereof is incident to the objective lens at the environmental temperature which is a second ambient temperature T_1 = 55 °C, ΔW defined by

$\Delta W = |W(\lambda_0, T_1) - W(\lambda_0, T_0)|$ (3)

satisfies a following formula:

$$\Delta W < 0.035\ \lambda rms \quad (4)$$

Please replace the paragraph beginning on page 38, line 15 with the following amended paragraph:

The operation and effect of this invention is the same as the operation and effect ~~of the invention of claim 2~~ consistent with the first embodiment.

Please replace the paragraph beginning on page 38, line 18 with the following amended paragraph:

An optical pickup device ~~of claim 23~~ according to a variation of the third embodiment is characterized in that~~, in the invention of claim 21 or 22,~~ the design wavelength λ_0 of the optical objective lens is not more than 500 nm, and in case that $fB(\lambda_0, T_0)$ is a back focal length of the objective lens when light having a wavelength of λ_0 (nm) is incident to the objective lens at an environmental temperature which is a first ambient temperature T_0 = 25 °C and $fB(\lambda_1, T_0)$ is a back focal length of the objective lens when light having a wavelength of λ_1 (nm) which is 5 nm longer than the wavelength of λ_0 is incident to the objective lens at the environmental temperature which is the first ambient temperature T_0 = 25 °C, ΔfB defined by

$$\Delta fB = |fB(\lambda_1, T_0) - fB(\lambda_0, T_0)| \quad (5)$$

satisfies a following formula:

$$\Delta fB < 0.001\ mm \quad (6)$$

Please replace the paragraph beginning on page 39, line 8 with the following amended paragraph:

The operation and effect of this invention is the same as the operation and effect ~~of the invention of claim 3~~ in accordance with the first embodiment.

Please replace the paragraph beginning on page 39, line 11 with the following amended paragraph:

An optical pickup device ~~of claim 24~~ according to a further variation of the third embodiment is characterized in that~~, in the invention of any one of claims 21 to 23,~~ the objective lens is an objective lens of a finite conjugate type for converging a diverging light beam emitted from the light source to the information recording surface of the optical information recording medium and satisfies a following formula:

$$0.8 > f > 0.2 \qquad (6A)$$

Please replace the paragraph beginning on page 39, line 19 with the following amended paragraph:

The operation and effect of this invention is the same as the operation and effect ~~of the invention of claim 4~~ consistent with the first embodiment.

Please replace the paragraph beginning on page 39, line 22 with the following amended paragraph:

An optical pickup device ~~of claim 25~~ according to another variation of the third embodiment is characterized in that~~, in the invention of claim 24,~~ m satisfies a following formula when m is an image formation magnification of the objective lens:

$$0.2 > |m| > 0.02 \qquad (6B)$$

Please replace the paragraph beginning on page 40, line 1 with the following amended paragraph:

The operation and effect of this invention is the same as the operation and effect of the ~~invention of claim 5~~ the first embodiment.

Please replace the paragraph beginning on page 40, line 4 with the following amended paragraph:

An optical pickup device ~~of claim 26~~ in accordance with a further variation of the third embodiment is characterized in that~~, in the invention of claim 24 or 25,~~ the objective lens and the light source are united by an actuator at least to be driven for tracking.

Please replace the paragraph beginning on page 40, line 8 with the following amended paragraph:

In an objective lens of an finite conjugate type to which a diverging light beam is made incident, coma aberration generated by tracking error is a problem. This reason

is that the emitting point becomes an off-axis object point for the objective lens when the objective lens is decentered from the emitting point of light source by tracking error. Though decentering of the objective lens due to tracking error is about 0.2 to 0.3 mm in an ordinary optical pickup device, the objective lens of the present invention is a lens having a short focal length satisfying the above-described formula (6A), and accordingly coma aberration and astigmatic aberration are generated significantly and it is impossible to perform good recording/reproducing to an optical information recording medium when the objective lens is decentered by about 0.2 to 0.3 mm by tracking error. Therefore, the optical pickup device of ~~claim 22~~ a variation of the third embodiment was configured such that the objective lens and the light source are united by an actuator at least to be driven for tracking. Thereby, it is possible to solve the problem that coma aberration and astigmatic aberration are generated by tracking error.

Please replace the paragraph beginning on page 41, line 3 with the following amended paragraph:

An optical pickup device ~~of claim 27~~ according to a fourth embodiment comprises: a light source; and a converging optical system including an objective lens for converging a light beam emitted from the light source to an information recording surface of an optical information recording medium, and is capable of recording and/or reproducing information by converging the light beam emitted from the light source to the information recording surface of the optical information recording medium with the converging optical system,

wherein the objective lens is a plastic single lens that comprises a ring-shaped phase structure on at least one optical surface, the ring-shaped phase structure comprising a plurality of ring surfaces and formed so that adjacent ring surfaces generate a predetermined optical path difference for incident light, and satisfies following formulas:

$$NA \geq 0.8 \quad (7)$$

$$1.3 > f > 0.2 \quad (8)$$

where NA is an image-side numerical aperture of the objective lens, which is required for recording and/or reproducing information for the optical information recording medium and f (mm) is a focal length of the objective lens.

Please replace the paragraph beginning on page 41, line 26 with the following amended paragraph:

The operation and effect of this invention is the same as the operation and effect of ~~claim 6~~ <u>the second embodiment</u>.

Please replace the paragraph beginning on page 42, line 2 with the following amended paragraph:

An optical pickup device ~~of claim 28~~ <u>consistent with a variation of the fourth embodiment</u> is characterized in that~~, in the invention of claim 27,~~ the ring-shaped phase structure is a diffraction structure having a function for diffracting predetermined incident light and the objective lens forms a converging wave front which is converged on the information recording surface owing to an effect obtained by combining a diffraction

effect and a refraction effect. The operation and effect of this invention is the same as the operation and effect ~~of claim 7~~ according to the second embodiment.

Please replace the paragraph beginning on page 42, line 12 with the following amended paragraph:

An optical pickup device ~~of claim 29~~ according to another variation of the fourth embodiment is characterized in that~~, in the invention of claim 28,~~ the objective lens has spherical aberration characteristics that spherical aberration changes in an undercorrected direction when a wavelength of the incident light changes to a longer wavelength. The operation and effect of this invention is the same as the operation and effect of ~~claim 8~~ the second embodiment.

Please replace the paragraph beginning on page 42, line 19 with the following amended paragraph:

An optical pickup device ~~of claim 30~~ consistent with a further variation of the fourth embodiment is characterized in that~~, in the invention of claim 28 or 29,~~ when an optical path difference added to a wave front transmitted through the diffraction structure is denoted by an optical path difference function Φ_b defined by

$$\Phi_b = b_2 \cdot h^2 + b_4 \cdot h^4 + b_6 \cdot h^6 + \ldots$$

(wherein b_2, b_4, b_6... are 2nd-order, 4th-order, 6th-order... optical path difference function coefficients, respectively), a following formula is satisfied:

$$-70 < (b_4 \cdot h_{MAX}^4)/(f \cdot \lambda_0 \cdot 10^{-6} \cdot (NA \cdot (1-m))^4) < -20 \qquad (8A)$$

wherein λ_0 (nm) is a design wavelength of the objective lens, h_{MAX} is an effective diameter maximum height (mm) of the optical surface on which the diffraction structure is formed and m is an image formation magnification of the objective lens. The operation and effect of this invention is the same as the operation and effect ~~of claim 9~~ consistent with the second embodiment.

Please replace the paragraph beginning on page 43, line 9 with the following amended paragraph:

An optical pickup device ~~of claim 31~~ according to a variation of the fourth embodiment is characterized in that~~, in the invention of claim 27,~~ the ring-shaped phase structure generates the predetermined optical path difference for the incident light by forming the adjacent ring surfaces so as to be displaced in an optical axis direction each other, and the objective lens forms a converging wave front which is converged on the information recording surface owing to a refraction effect. The operation and effect of this invention is the same as the operation and effect ~~of claim 10~~ according to the second embodiment.

Please replace the paragraph beginning on page 43, line 19 with the following amended paragraph:

The optical pickup device ~~of claim 32~~ according to the fourth embodiment is characterized in that~~, in the invention of claim 31,~~ when a ring surface including an optical axis is called a central ring surface, a ring surface adjacent to an outside of the central ring surface is formed to be displaced in the optical axis direction so as to have a

shorter optical path length than the central ring surface, a ring surface at a maximum effective diameter position is formed to be displaced in the optical axis direction so as to have a longer optical path length than an ring surface adjacent to an inside thereof, and a ring surface at a position of 75% of a maximum effective diameter is formed to be displaced so as to have a shorter optical path length than a ring surface adjacent to an inside thereof and a ring surface adjacent to an outside thereof. The operation and effect of this invention is the same as the operation and effect ~~of claim 11~~ in accordance with the second embodiment.

Please replace the paragraph beginning on page 44, line 10 with the following amended paragraph:

An optical pickup device ~~of claim 33~~ consistent with a variation of the fourth embodiment is characterized in that~~, in the invention of claim 21 or 22,~~ a total of the ring surfaces is from 3 to 20. The operation and effect of this invention is the same as the operation and effect ~~of claim 12~~ according to the second embodiment.

Please replace the paragraph beginning on page 44, line 15 with the following amended paragraph:

An optical pickup device ~~of claim 34~~ according to a variation of the fourth embodiment is characterized in that~~, in the invention of any one of claims 21 to 23,~~ when Δ_j (μm) is a step amount of an arbitrary step of steps in the optical axis direction at a boundary of mutually adjacent ring surfaces in a ring-shaped phase structure formed in a region from a height of 75% to a height of 100% of an effective diameter maximum

height of the optical surface on which the ring-shaped phase structure is formed and n is a refractive index of the objective lens at a design wavelength of λ_0 (nm), m_j represented by

$$m_j = INT(X) \qquad (8B)$$

(wherein $X = \Delta_j \cdot (n-1)/(\lambda_0 \cdot 10^{-3})$ and INT(X) is an integer obtained by half adjust of X) is an integer not less than 2. The operation and effect of this invention is the same as the operation and effect of ~~claim 13~~ the second embodiment.

Please replace the paragraph beginning on page 45, line 4 with the following amended paragraph:

An optical pickup device [[of 35]] in accordance with the fourth embodiment is characterized in that~~, in the invention of any one of claims 27 to 34,~~ when $W(\lambda_0, T_0)$ is an RMS value of residual aberration of the objective lens when light having a wavelength of λ_0 (nm) which is a design wavelength thereof is incident to the objective lens at an environmental temperature which is a first ambient temperature T_0 = 25 °C, $W(\lambda_1, T_0)$ is an RMS value of residual aberration of the objective lens when light having a wavelength of λ_1 (nm) which is 5 nm longer than the wavelength of λ_0 is incident to the objective lens at the environmental temperature which is the first ambient temperature T_0 = 25 °C and $W(\lambda_2, T_1)$ is an RMS value of residual aberration of the objective lens when light having a wavelength of λ_2 (nm) is incident to the objective lens at the environmental temperature which is a second ambient temperature T_1 = 55 °C, $\Delta W1$ and $\Delta W2$ defined by

$$\Delta W1 = |W(\lambda_2, T_1) - W(\lambda_0, T_0)| \qquad (9)$$

$$\Delta W2 = |W(\lambda_1, T_0) - W(\lambda_0, T_0)| \quad (10)$$

satisfy following formulas:

$$\Delta W1 < 0.035\ \lambda rms \quad (11)$$

$$\Delta W2 < 0.035\ \lambda rms \quad (12)$$

wherein

when $\lambda_0 < 600$ nm, $\lambda_2 = \lambda_0 + 1.5$ (nm) and

when $\lambda_0 \geq 600$ nm, $\lambda_2 = \lambda_0 + 6$ (nm).

Please replace the paragraph beginning on page 46, line 2 with the following amended paragraph:

The operation and effect of this invention is the same as the operation and effect ~~of claim 14~~ consistent with the second embodiment.

Please replace the paragraph beginning on page 46, line 27 with the following amended paragraph:

Preferably, an optical pickup device [[of 36]] according to the fourth embodiment satisfies a following formula ~~in the invention of claim 35~~:

$$\sqrt{((\Delta W1)^2 + (\Delta W2)^2)} < 0.05\ \lambda rms \quad (13)$$

Please replace the paragraph beginning on page 46, line 7 with the following amended paragraph:

The operation and effect of this invention is the same as the operation and effect of ~~claim 15~~ the second embodiment.

Please replace the paragraph beginning on page 46, line 9 with the following amended paragraph:

In an optical pickup device ~~of claim 37~~ consistent with the fourth embodiment, ~~in the present invention of any one of claims 27 to 36~~, the objective lens is an objective lens of a finite conjugate type for converging a diverging light beam emitted from the light source on the information recording surface and satisfies a following formula:

$$1.1 > f > 0.2 \tag{13A}$$

The operation and effect of this invention is the same as the operation and effect ~~of claim 16~~ consistent with the second embodiment.

Please replace the paragraph beginning on page 46, line 18 with the following amended paragraph:

An optical pickup device ~~of claim 38~~ according to a variation of the fourth embodiment satisfies a following formula when m is an image formation magnification of the objective lens in the invention of ~~claim 37~~ the previous variation of the fourth embodiment:

$$0.2 > |m| > 0.02 \tag{13B}$$

The operation and effect of this invention is the same as the operation and effect ~~of claim 17~~ in accordance with the second embodiment.

Please replace the paragraph beginning on page 46, line 25 with the following amended paragraph:

An optical pickup device ~~of claim 39~~ consistent with the fourth embodiment is characterized in that~~, in the invention of claim 37 or 38,~~ the objective lens and the light source are united by an actuator at least to be driven for tracking. The operation and effect of this invention is the same as the operation and effect ~~of claim 26~~ according to the third embodiment.

Please replace the paragraph beginning on page 47, line 5 with the following amended paragraph:

An optical pickup device of ~~claim 40~~ the present invention, satisfies a following formula ~~in the invention of any one of claims 21 to 39~~:

$$0.8 < d/f < 1.8 \tag{14}$$

where d (mm) is a lens thickness in an optical axis of the objective lens and f (mm) is a focal length.

Please replace the paragraph beginning on page 47, line 11 with the following amended paragraph:

The operation and effect of this invention is the same as the operation and effect ~~of claim 18~~ consistent with the second embodiment.

Please replace the paragraph beginning on page 47, line 13 with the following amended paragraph:

An optical pickup device of ~~claim 41~~ the present invention is characterized in that~~,~~ ~~in the invention of any one of claims 21 to 40,~~ the design wavelength of λ_0 (nm) of the objective lens satisfies a following formula:

$$500 \leq \lambda_0 \geq 350 \qquad (15)$$

Please replace the paragraph beginning on page 47, line 18 with the following amended paragraph:

The operation and effect of this invention is the same as the operation and effect of ~~claim 19~~ in accordance with the second embodiment.

Please replace the paragraph beginning on page 47, line 20 with the following amended paragraph:

An optical pickup device of ~~claim 42~~ the present invention satisfies a following formula ~~in the invention of any one of claims 21 to 41~~:

$$0.40 \leq (X1 - X2) \cdot (N - 1)/(NA \cdot f \cdot \sqrt{(1 + |m|)}) \leq 0.63 \qquad (16)$$

wherein

X1: a distance (mm) in an optical axis direction between a plane that is perpendicular to an optical axis and tangent to a top of an optical surface on a light source side and an optical surface on the light source side in a most peripheral portion of an effective diameter (position of the NA on a surface on the light source side to which a marginal light beam is made incident), wherein plus is a case of measurement

for a direction of the optical information recording medium with reference to the tangent plane and minus is a case of measurement for a direction of the light source,

X2: a distance (mm) in an optical axis direction between a plane that is perpendicular to an optical axis and tangent to a top of an optical surface on an optical information recording medium side and an optical surface on the optical information recording medium side in a most peripheral portion of an effective diameter (position of the NA on a surface on the optical information recording medium side to which a marginal light beam is made incident), wherein plus is a case of measurement for a direction of the optical information recording medium with reference to the tangent plane and minus is a case of measurement for a direction of the light source,

N: a refractive index of the objective lens at the design wavelength of λ_0,

f: a focal length (mm) of the objective lens, and

m: an image formation magnification of the objective lens.

Please replace the paragraph beginning on page 49, line 1 with the following amended paragraph:

The operation and effect of this invention is the same as the operation and effect ~~of claim 20~~ consistent with the second embodiment.

Please replace the paragraph beginning on page 49, line 3 with the following amended paragraph:

An optical information recording/reproducing apparatus ~~of claim 43~~ according to the fifth embodiment comprises optical pickup device that comprises: a light source; and

a converging optical system including an objective lens for converging a light beam emitted from the light source to an information recording surface of an optical information recording medium, and is capable of recording and/or reproducing information by converging the light beam emitted from the light source to the information recording surface of the optical information recording medium with the converging optical system, wherein the objective lens is a plastic single lens and satisfies following formulas:

$$NA \geq 0.8 \qquad (1)$$

$$1.0 > f > 0.2 \qquad (2)$$

where NA is an image-side numerical aperture of the objective lens, which is required for recording and/or reproducing information to the optical information recording medium and f (mm) is a focal length of the objective lens.

Please replace the paragraph beginning on page 49, line 24 with the following amended paragraph:

The operation and effect of this invention is the same as the operation and effect ~~of claim 1~~ consistent with the first embodiment.

Please replace the paragraph beginning on page 49, line 26 with the following amended paragraph:

An optical information recording/reproducing apparatus ~~of claim 44~~ according to a variation of the fifth embodiment is characterized in that~~, in the invention of claim 43,~~ when $W(\lambda_0, T_0)$ is an RMS value of residual aberration of the objective lens when light

having a wavelength of λ_0 (nm) which is a design wavelength thereof is incident to the objective lens at an environmental temperature which is a first ambient temperature T_0 = 25 °C and $W(\lambda_0, T_1)$ is an RMS value of residual aberration of the objective lens when light having the wavelength of λ_0 (nm) which is a design wavelength thereof is incident to the objective lens at the environmental temperature which is a second ambient temperature T_1 = 55 °C, ΔW defined by

$$\Delta W = |W(\lambda_0, T_1) - W(\lambda_0, T_0)| \quad (3)$$

satisfies a following formula:

$$\Delta W < 0.035\ \lambda rms \quad (4)$$

Please replace the paragraph beginning on page 50, line 15 with the following amended paragraph:

The operation and effect of this invention is the same as the operation and effect ~~of claim 2~~ according to the first embodiment.

Please replace the paragraph beginning on page 50, line 17 with the following amended paragraph:

An optical information recording/reproducing apparatus ~~of claim 45~~ in accordance with a variation of the fifth embodiment is characterized in that~~, in the invention of claim 43 or 44,~~ the design wavelength λ_0 of the optical objective lens is not more than 500 nm, and in case that $fB(\lambda_0, T_0)$ is a back focal length of the objective lens when light having a wavelength of λ_0 (nm) is incident to the objective lens at an environmental temperature which is a first ambient temperature T_0 = 25 °C and $fB(\lambda_1, T_0)$ is a back focal length of

the objective lens when light having a wavelength of λ_1 (nm) which is 5 nm longer than the wavelength of λ_0 is incident to the objective lens at the environmental temperature which is the first ambient temperature T_0 = 25 °C, ΔfB defined by

$$\Delta fB = |fB(\lambda_1, T_0) - fB(\lambda_1, T_0)| \qquad (5)$$

satisfies a following formula:

$$\Delta fB < 0.001 \text{ mm} \qquad (6)$$

Please replace the paragraph beginning on page 51, line 7 with the following amended paragraph:

The operation and effect of this invention is the same as the operation and effect ~~of claim 3~~ according to the first embodiment.

Please replace the paragraph beginning on page 51, line 9 with the following amended paragraph:

An optical information recording/reproducing apparatus ~~of claim 46~~ according to the fifth embodiment is characterized in that~~, in the invention of any one of claims 43 to 45,~~ the objective lens is an objective lens of a finite conjugate type for converging a diverging light beam emitted from the light source to the information recording surface of the optical information recording medium and satisfies a following formula:

$$0.8 > f > 0.2 \qquad (6A)$$

The operation and effect of this invention is the same as the operation and effect of ~~claim 4~~ the first embodiment.

Please replace the paragraph beginning on page 51, line 20 with the following amended paragraph:

An optical information recording/reproducing apparatus ~~of claim 47~~ in accordance with the fifth embodiment is characterized in that~~, in the invention of claim 46,~~ m satisfies a following formula when m is an image formation magnification of the objective lens:

$$0.2 > |m| > 0.02 \qquad (6B)$$

The operation and effect of this invention is the same as the operation and effect of ~~claim 5~~ consistent with the first embodiment.

Please replace the paragraph beginning on page 52, line 2 with the following amended paragraph:

An optical information recording/reproducing apparatus ~~of claim 48~~ ~~according to a further variation of the fifth embodiment~~ is characterized in that~~, in the invention of claim 46 or 47,~~ the objective lens and the light source are united by an actuator at least to be driven for tracking. The operation and effect of this invention is the same as the operation and effect of ~~claim 26~~ the third embodiment.

Please replace the paragraph beginning on page 52, line 9 with the following amended paragraph:

An optical information recording/reproducing apparatus ~~of claim 49~~ according to the sixth embodiment comprises an optical pickup device that comprises: a light source; and a converging optical system including an objective lens for converging a light beam

emitted from the light source to an information recording surface of an optical information recording medium, and is capable of recording and/or reproducing information by converging the light beam emitted from the light source to the information recording surface of the optical information recording medium with the converging optical system, wherein the objective lens is a plastic single lens that comprises a ring-shaped phase structure on at least one optical surface, the ring-shaped phase structure comprising a plurality of ring surfaces and formed so that adjacent ring surfaces generate a predetermined optical path difference for incident light, and satisfies following formulas:

$$NA \geq 0.8 \quad (7)$$

$$1.3 > f > 0.2 \quad (8)$$

where NA is an image-side numerical aperture of the objective lens, which is required for recording and/or reproducing information for the optical information recording medium and f (mm) is a focal length of the objective lens.

Please replace the paragraph beginning on page 53, line 7 with the following amended paragraph:

The operation and effect of this invention is the same as the operation and effect ~~of claim 6~~ consistent with the second embodiment.

Please replace the paragraph beginning on page 53, line 9 with the following amended paragraph:

An optical information recording/reproducing apparatus ~~of claim 50~~ consistent with a variation of the sixth embodiment is characterized in that~~, in the invention of claim 49,~~ the ring-shaped phase structure is a diffraction structure having a function for diffracting predetermined incident light and the objective lens forms a converging wave front which is converged on the information recording surface owing to an effect obtained by combining a diffraction effect and a refraction effect. The operation and effect of this invention is the same as the operation and effect ~~of claim 7~~ according to the second embodiment.

Please replace the paragraph beginning on page 53, line 19 with the following amended paragraph:

An optical information recording/reproducing apparatus ~~of claim 51~~ according to the sixth embodiment is characterized in that~~, in the invention of claim 50,~~ the objective lens has spherical aberration characteristics that spherical aberration changes in an undercorrected direction when a wavelength of the incident light changes to a longer wavelength. The operation and effect of this invention is the same as the operation and effect of ~~claim 8~~ the second embodiment.

Please replace the paragraph beginning on page 54, line 1 with the following amended paragraph:

An optical information recording/reproducing apparatus ~~of claim 52~~ in accordance with the sixth embodiment is characterized in that~~, in the invention of claim 50 or 51,~~ when an optical path difference added to a wave front transmitted through the diffraction structure is denoted by an optical path difference function Φ_b defined by

$$\Phi_b = b_2 \cdot h^2 + b_4 \cdot h^4 + b_6 \cdot h^6 + \ldots$$

(wherein b_2, b_4, b_6... are 2nd-order, 4th-order, 6th-order... optical path difference function coefficients, respectively), a following formula is satisfied:

$$-70 < (b_4 \cdot h_{MAX}{}^4)/(f \cdot \lambda_0 \cdot 10^{-6} \cdot (NA \cdot (1-m))^4) < -20 \qquad (8A)$$

wherein λ_0 (nm) is a design wavelength of the objective lens, h_{max} is an effective diameter maximum height (mm) of the optical surface on which the diffraction structure is formed and m is an image formation magnification of the objective lens. The operation and effect of this invention is the same as the operation and effect ~~of claim 9~~ in accordance with the second embodiment.

Please replace the paragraph beginning on page 54, line 18 with the following amended paragraph:

An optical information recording/reproducing apparatus ~~of claim 53~~ according to a further variation of the sixth embodiment is characterized in that~~, in the invention of claim 49,~~ the ring-shaped phase structure generates the predetermined optical path difference for the incident light by forming the adjacent ring surfaces so as to be displaced in an optical axis direction each other, and the objective lens forms a

converging wave front which is converged on the information recording surface owing to a refraction effect. The operation and effect of this invention is the same as the operation and effect ~~of claim 10~~ consistent with the second embodiment.

Please replace the paragraph beginning on page 55, line 3 with the following amended paragraph:

The optical information recording/reproducing apparatus ~~of claim 54~~ consistent with a variation of the sixth embodiment is characterized in that~~, in the invention of claim 53,~~ when a ring surface including an optical axis is called a central ring surface, a ring surface adjacent to an outside of the central ring surface is formed to be displaced in the optical axis direction so as to have a shorter optical path length than the central ring surface, a ring surface at a maximum effective diameter position is formed to be displaced in the optical axis direction so as to have a longer optical path length than a ring surface adjacent to an inside thereof, and a ring surface at a position of 75% of a maximum effective diameter is formed to be displaced so as to have a shorter optical path length than a ring surface adjacent to an inside thereof and a ring surface adjacent to an outside thereof. The operation and effect of this invention is the same as the operation and effect ~~of claim 11~~ in accordance with the second embodiment.

Please replace the paragraph beginning on page 55, line 20 with the following amended paragraph:

An optical information recording/reproducing apparatus [[of 55]] according to the sixth embodiment is characterized in that~~, in the invention of claim 53 or 54,~~ a total of

the ring surfaces is from 3 to 20. The operation and effect of this invention is the same as the operation and effect of ~~claim 12~~ the second embodiment.

Please replace the paragraph beginning on page 55, line 25 with the following amended paragraph:

An optical information recording/reproducing apparatus ~~of claim 56~~ consistent with a variation of the sixth embodiment is characterized in that~~, in the invention of any one of claims 53 to 55,~~ when Δ_j (μm) is a step amount of an arbitrary step of steps in the optical axis direction at a boundary of mutually adjacent ring surfaces in a ring-shaped phase structure formed in a region from a height of 75% to a height of 100% of an effective diameter maximum height of the optical surface on which the ring-shaped phase structure is formed and n is a refractive index of the objective lens at a design wavelength of λ_0 (nm), m_j represented by

$$m_j = INT(X) \qquad (8B)$$

(wherein $X = \Delta_j \cdot (n-1)/(\lambda_0\ 10^{-3})$ and INT(X) is an integer obtained by half adjust of X) is an integer not less than 2. The operation and effect of this invention is the same as the operation and effect ~~of claim 13~~ in accordance with the second embodiment.

Please replace the paragraph beginning on page 56, line 15 with the following amended paragraph:

An optical information recording/reproducing apparatus ~~of claim 57~~ consistent with the sixth embodiment is characterized in that~~, in the invention of any one of claims 49 to 56,~~ in case that $W(\lambda_0, T_0)$ is an RMS value of residual aberration of the objective

lens when light having a wavelength of λ_0 (nm) which is a design wavelength thereof is incident to the objective lens at an environmental temperature which is a first ambient temperature $T_0 = 25$ °C, $W(\lambda_1, T_0)$ is an RMS value of residual aberration of the objective lens when light having a wavelength of λ_1 (nm) which is 5 nm longer than the wavelength of λ_0 is incident to the objective lens at the environmental temperature which is the first ambient temperature $T_0 = 25$ °C, and $W(\lambda_2, T_1)$ is an RMS value of residual aberration of the objective lens when light having a wavelength of λ_2 (nm) is incident to the objective lens at the environmental temperature which is a second ambient temperature $T_1 = 55$ °C, ΔW1 and ΔW2 defined by

$$\Delta W1 = |W(\lambda_2, T_1) - W(\lambda_0, T_0)| \qquad (9)$$

$$\Delta W2 = |W(\lambda_1, T_0) - W(\lambda_0, T_0)| \qquad (10)$$

satisfy following formulas:

$$\Delta W1 < 0.035\ \lambda rms \qquad (11)$$

$$\Delta W2 < 0.035\ \lambda rms \qquad (12)$$

wherein

when $\lambda_0 < 600$ nm, $\lambda_0 = \lambda_0 + 1.5$ (nm) and

when $\lambda_0 \geq 600$ nm, $\lambda_2 = \lambda_0 + 6$ (nm).

Please replace the paragraph beginning on page 57, line 14 with the following amended paragraph:

The operation and effect of this invention is the same as the operation and effect ~~of claim 14~~ according to the second embodiment.

Please replace the paragraph beginning on page 57, line 16 with the following amended paragraph:

Preferably, an optical information recording/reproducing apparatus of ~~claim 58~~ a variation of the sixth embodiment satisfies a following formula ~~in the invention of claim 47~~:

$$\sqrt{((\Delta W1)^2 + (\Delta W2)^2)} < 0.05\ \lambda rms \qquad (13)$$

Please replace the paragraph beginning on page 57, line 20 with the following amended paragraph:

The operation and effect of this invention is the same as the operation and effect ~~of claim 15~~ according to the second embodiment.

Please replace the paragraph beginning on page 57, line 22 with the following amended paragraph:

An optical information recording/reproducing apparatus ~~of claim 59~~ consistent with the sixth embodiment is characterized in that~~, in the invention of any one of claims 49 to 58 being~~ an objective lens of a finite conjugate type for converging a diverging light beam emitted from the light source on the information recording surface ~~and satisfying~~ satisfies a following formula. The operation and effect of this invention is the same as the operation and effect ~~of claim 16~~ consistent with the second embodiment.

$$1.1 > f > 0.2 \qquad (13A)$$

Please replace the paragraph beginning on page 58, line 5 with the following amended paragraph:

An optical information recording/reproducing apparatus ~~of claim 60~~ according to a variation of the sixth embodiment satisfies a following formula when m is an image formation magnification of the objective lens ~~in the invention of claim 59~~ consistent with a variation of the sixth embodiment.

Please replace the paragraph beginning on page 58, line 9 with the following amended paragraph:

The operation and effect of this invention is the same as the operation and effect of ~~claim 17~~ the second embodiment.

Please replace the paragraph beginning on page 58, line 12 with the following amended paragraph:

An optical information recording/reproducing apparatus ~~of claim 61~~ in accordance with a variation of the sixth embodiment is characterized in that~~, in the invention of claim 59 or 60,~~ the objective lens and the light source are united by an actuator at least to be driven for tracking. The operation and effect of this invention is the same as the operation and effect of ~~claim 26~~ the third embodiment.

Please replace the paragraph beginning on page 58, line 19 with the following amended paragraph:

An optical information recording/reproducing apparatus of ~~claim 62~~ the present invention satisfies a following formula ~~in the present invention of any one of claims 43 to 61~~:

$$0.8 < d/f < 1.8 \qquad (14)$$

where d (mm) is a lens thickness in an optical axis of the objective lens and f (mm) is a focal length.

Please replace the paragraph beginning on page 58, line 25 with the following amended paragraph:

The operation and effect of this invention is the same as the operation and effect ~~of claim 18~~ consistent with the second embodiment.

Please replace the paragraph beginning on page 59, line 1 with the following amended paragraph:

An optical information recording/reproducing apparatus of ~~claim 63~~ the present invention is characterized in that~~, in the invention of any one of claims 43 to 62,~~ the design wavelength of λ_0 (nm) of the objective lens satisfies a following formula:

$$500 \geq \lambda_0 \geq 350 \qquad (15)$$

Please replace the paragraph beginning on page 59, line 7 with the following amended paragraph:

The operation and effect of this invention is the same as the operation and effect of ~~claim 19~~ the second embodiment.

Please replace the paragraph beginning on page 59, line 9 with the following amended paragraph:

An optical information recording/reproducing apparatus of ~~claim 64~~ the present invention satisfies a following formula ~~in the invention of any one of claims 43 to 63~~:

$$0.40 \leq (X1 - X2) \cdot (N - 1)/(NA \cdot f \cdot \sqrt{(1 + |m|)}) \leq 0.63 \qquad (16)$$

where

X1: a distance (mm) in an optical axis direction between a plane that is perpendicular to an optical axis and tangent to a top of an optical surface on a light source side and an optical surface on the light source side in a most peripheral portion of an effective diameter (position of the NA on a surface on the light source side to which a marginal light beam is incident), wherein X1 is plus in a case of measuring X1 in a direction of the optical information recording medium with reference to the tangent plane, and minus in a case of measuring X1 in a direction of the light source,

X2: a distance (mm) in an optical axis direction between a plane that is perpendicular to an optical axis and tangent to a top of an optical surface on an optical information recording medium side and an optical surface on the optical information recording medium side in a most peripheral portion of an effective diameter (position of the NA on a surface on the optical information recording medium side to which a

marginal light beam is incident), wherein X2 is plus in a case of measuring X2 in a direction of the optical information recording medium with reference to the tangent plane and minus ina case of measuring X2 in a direction of the light source,

N: a refractive index of the objective lens at the design wavelength of λ_0,

f: a focal length (mm) of the objective lens, and

m: an image formation magnification of the objective lens.

Please replace the paragraph beginning on page 60, line 16 with the following amended paragraph:

The operation and effect of this invention is the same as the operation and effect ~~of claim 20~~ in accordance with the second embodiment.

Please replace the paragraph beginning on page 78, line 1 with the following amended paragraph:

As for the objective lens of Example 2, a value of ΔW1 (formula (9)) is Δw1 = 0.019 λrms because of $W(\lambda_0, T_0)$ = 0.001 λrms (λ_0 = 405 nm and T_0 = 25 °C) and $W(\lambda_2, T_1)$ = 0.020 λrms (λ_2 = 406.5 nm and T_1 = 55 °C). A value of ΔW2 (formula (10)) is ΔW2 = 0.021 λrms because of $W(\lambda_0, T_0)$ = 0.001 λrms (λ_0 = 405 nm and T_0 = 25 °C) and $W(\lambda_1, T_0)$ = 0.022 λrms ($\lambda_{[[2]]\underline{1}}$ = 410 nm and T_0 = 25 °C). A value of the formula (8A) in Example 2 is -42.

Please replace the paragraph beginning on page 78, line 26 with the following amended paragraph:

As for the objective lens of Example 3, a value of ΔW1 (formula (9)) is ΔW1 = 0.013 λrms because of $W(\lambda_0, T_0)$ = 0.002 λrms (λ_0 = 405 nm and T_0 = 25 °C) and $W(\lambda_2, T_1)$ = 0.015 λrms (λ_2 = 406.5 nm and T_1 = 55 °C). A value of ΔW2 (formula (10)) is ΔW2 = 0.013 λrms because of $W(\lambda_0, T_0)$ = 0.002 λrms (λ_0 = 405 nm and T_0 = 25 °C) and $W(\lambda_1, T_1)$ = 0.015 λrms ($\lambda_{[[2]]\,\underline{1}}$ = 410 nm and T_0 = 25 °C). As for values of the formula (8B) in Example 3, the 5th ring surface is m_j = 3 and the 6th ring surface is m_j = 3.